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EPA Superfund
Record of Decision:

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PHILADELPHIA, PA
10/25/1999

DECLARATION

SITE NAME AND LOCATION

Navy Installation Restoration (IR) Program Site 13 **S** Fire Training Area

Philadelphia Naval Complex
Philadelphia, Pennsylvania

STATEMENT OF BASIS AND PURPOSE

The purpose of this Decision Document is to document the Navy's decision, in consultation with the Base Realignment and Closure (BRAC Cleanup Team's (BCT), that no further action is required at the site listed above to protect current or future users or the environment. No further action at this site means that there are no corrective measures required to ensure adequate protection of human health and the environment for continued use of this site in an industrial or commercial capacity. The BCT is comprised of the U.S. Environmental Protection Agency (USEPA) Region III, Pennsylvania Department of Environmental Protection (PADEP), the Philadelphia Industrial Development Corporation (PIDC), and the Navy.

This No Further Action Decision Document for the site listed above is based on the results of the Remedial Investigation (RI) and follow-up investigations at the site, which included an evaluation of human health risk posed from this site, and an evaluation of this site's impact to the environment (i.e., ecological habitat assessment). This Decision Document has been prepared in accordance with USEPA guidelines for preparation of Decision Documents (USEPA 1989a).

PADEP and USEPA Region III concur with the selected No Further Action.

DESCRIPTION OF SELECTED REMEDY: NO FURTHER ACTION

The site listed above is part of the Navy IR Program at the Philadelphia Naval Complex. The site is located within designated Reuse Zone I, which is scheduled to be transferred from the Navy to another owner under the Navy's BRAC program. The selected remedy for this site is "No Further Action." No further action at this site means that there are no corrective measures required to ensure adequate protection of human health and the environment for continued use of this site in a non-residential capacity. A determination has been made that a condition of no significant risk to health, safety, and public welfare or the environment exists so long as activities, development, improvement made on, or uses of the site are consistent with those identified in the Community Reuse Plan, dated September 1994. Residential use exposures were not evaluated for this site, as it was not deemed to be consistent with future reuse. Future residential use, outdoor child care and use of shallow ground water as a potable drinking water source are restricted by basewide Institutional Controls as documented in the Basewide Decision Document (US Navy 1998). As such, there has been no evaluation of the suitability of the site listed in this document for future residential uses.

DECLARATION STATEMENT

This Decision Document represents the selected action that is protective of human health and the environment under current and reasonable maximum exposure scenarios and considers the appropriate regulatory health and environmental criteria. The Navy has determined that a condition of no significant risk to health, safety, and public welfare of the environment exists, so long as activities, development, improvement made on or uses of the site are consistent with those identified in the Community Reuse Plan, dated September 1994. It has been determined that the No Further Action remedy, in light of the aforementioned basewide restrictions, is readily implementable and will be protective of the public and the environment.

Signature

Joseph M. Roche
BRAC Environmental Coordinator

25 October 1995
Date

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LIST OF ACRONYMS AND ABBREVIATIONS

AL	Action Level
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Constituent(s) of Potential Concern
CS	Confirmation Study
DCE	Dichloroethene
DD	Decision Document
EA	EA Engineering, Science, and Technology, Inc.
EPIC	Environmental Photographic Interpretation Center
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
IR	Installation Restoration
MCL	Maximum Contaminant Level
NACIP	Navy Assessment and Control of Installation Pollutants
NAVBASE	Philadelphia Naval Base
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Services Center
NOFA	No Further Action
PADEP	Pennsylvania Department of Environmental Protection
PAH	Polycyclic Aromatic Hydrocarbons
PCA	Tetrachloroethane
PCB	Polychlorinated Biphenyls
RA	Remedial Action
RAB	Restoration Advisory Board
RBC	Risk-Based Concentration
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
SVOC	Semivolatile Organic Compound(s)

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound(s)

1. INTRODUCTION

This Decision Document supports "No Further Action" for Navy Installation Restoration (IR) Program Site 13 (Fire Training Area) at the Philadelphia Naval Complex.

The purpose of the Decision Document is to summarize existing information for the site and describe the Department of the Navy's rationale for selecting the No Further Action remedy. The objectives of the Decision Document for the site are:

1. To briefly describe the location, history, and environmental setting;
2. To summarize the results from the remedial investigation (RI) (EA 1999) and describe the current status of the site; and
3. To present and evaluate the risk to human health and the environment.

Data resulting from the remedial investigation (RI) (EA 1999) were used to derive and support the selection of a No Further Action decision for the site.

1.1 SITE LOCATION

Site 13 is located in Reuse Zone I of Philadelphia Naval Complex, 4 miles south of Philadelphia, Pennsylvania, at the confluence of the Delaware and Schuylkill Rivers. Figure 1 shows the location of the site.

1.1.1 Demographics

The surrounding community is predominantly commercial/industrial in the immediate vicinity and zoned accordingly. Downtown Philadelphia is approximately 3 miles north with outlying urban residential areas as close as 1 mile to the north of the site. These residential districts are zoned for lower density residential development. To the north of the Philadelphia Naval Base there is a recreational facility comprised of the First Union Center, Veterans Stadium, and other public entertainment facilities.

1.1.2 Surface- and Ground-Water Resources and Site Geology

There are no surface water bodies on the site.

The geologic units beneath the site are part of the Potomac Group and Raritan Formation, which are composed of interbedded gravel, silt, sand, and clay units. These sediments comprise the Potomac-Raritan-Magothy aquifer system, which is subdivided into the following units: lower sand, lower clay, middle sand, middle clay, upper sand, and upper clay. In much of these areas

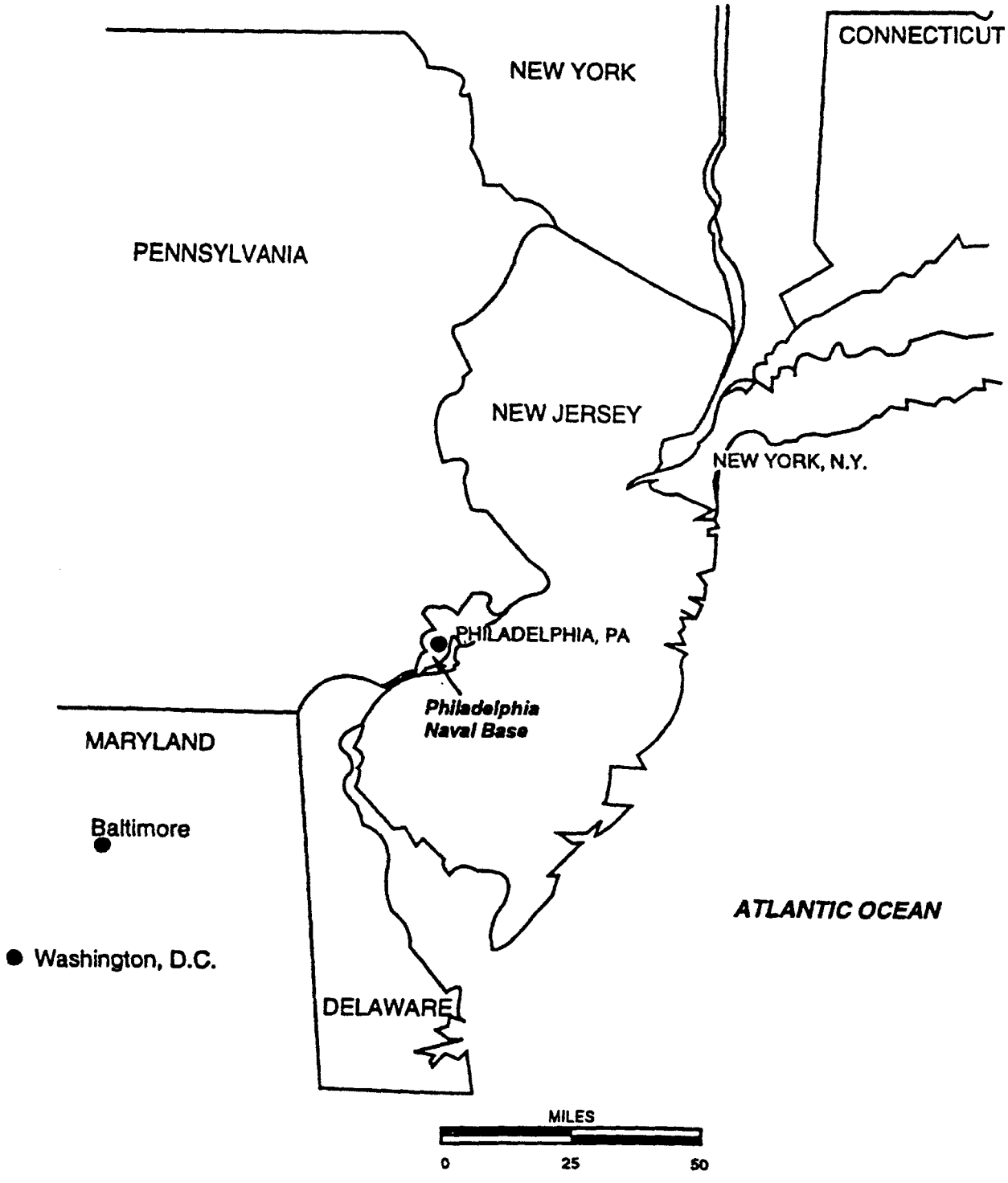

Figure 1. General Vicinity Map, Philadelphia Naval Base, Pennsylvania.

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the Cretaceous sediments are overlain by Pleistocene sediment informally named the Trenton Gravel. Much of the shallow subsoil is reworked fill and made-land from dredge spoils from the Delaware River. The site falls within the stream flow source zone of the New Jersey Coastal Area Aquifer. The deep ground-water aquifer is used as a drinking water source in New Jersey. This aquifer has been designated a sole source aquifer for drinking water by the U.S. Environmental Protection Agency (USEPA) under Section 1424(e) of the Safe Drinking Water Act, Public Law 93-523. The aquifer is considered highly susceptible to contamination through its recharge and stream flow source zones.

Neither the shallow nor deep ground water are considered drinking water sources at the Philadelphia Naval Base. Drinking water in the Philadelphia area is supplied by public water systems. Wells installed in the Lower and Middle Sand units originally supplied water to the Philadelphia Naval Base. These deep wells were abandoned in the 1960s, with conversion to municipal water supplies. U.S. Geological Survey (USGS) summarized the ground-water flow and quality conditions in the report *Ground-Water-Flow and Quality Conditions at the Philadelphia Naval Complex, Philadelphia, Pennsylvania* (USGS 1996). Ground-water samples were collected from these deep wells in July 1997. The analyses indicate that the ground water has not been adversely impacted (EA 1997).

Ground-water modeling conducted by the Navy (EA 1996) assessed potential transport of constituents of potential concern (COPC) from shallow ground water at the Philadelphia Naval Complex to the production wells in New Jersey. The results indicated no significant potential for impact to the deep aquifer.

A basewide evaluation of the characteristics of ground-water flow across the Philadelphia Naval Base was completed. The report (EA 1998) summarizes previously collected data and studies, as well as additional data collected to fill data gaps and complete a basewide perspective. The report concluded that no ground-water restrictions were required, other than restrictions on the use of shallow ground water for human consumption.

Site 13 geology generally consists of a surficial sand and gravel unit, which extends from below paving to approximately 4 ft, underlain by a sandy silt lithology and then a well-graded sand. Two water-bearing zones have been identified, including a perched water table in the low permeability sandy silt and the water table in the lower sand lithology. The upper water-bearing unit flows toward the southeast. The lower water-bearing unit flows toward the south-southeast. Vertical gradients indicate downward flow from the perched to the water-table aquifer. The deeper, confined ground-water aquifer was evaluated as part of other studies.

1.2 SITE BACKGROUND

Investigations to identify sites of potential environmental concern at the Philadelphia Naval Complex commenced in 1980. In September 1980, the Navy Assessment and Control of Installation Pollutants (NACIP) program was instituted to identify and investigate Naval facilities, in order to locate operations which may have created a potential environmental, health,

or safety hazard. The NACIP program provided for the development and implementation of appropriate remedial actions in areas where significant hazards were confirmed. It had three major components: the Initial Assessment Study (IAS), the Confirmation Study (CS), and Remedial Action (RA).

The NACIP Office awarded Navy Contract No. N62474-82-C-C354 to Envirodyne Engineers, Inc. to conduct the IAS at the Philadelphia Naval Base (NAVBASE). Eleven potential sites were identified; four of these were recommended for a CS.

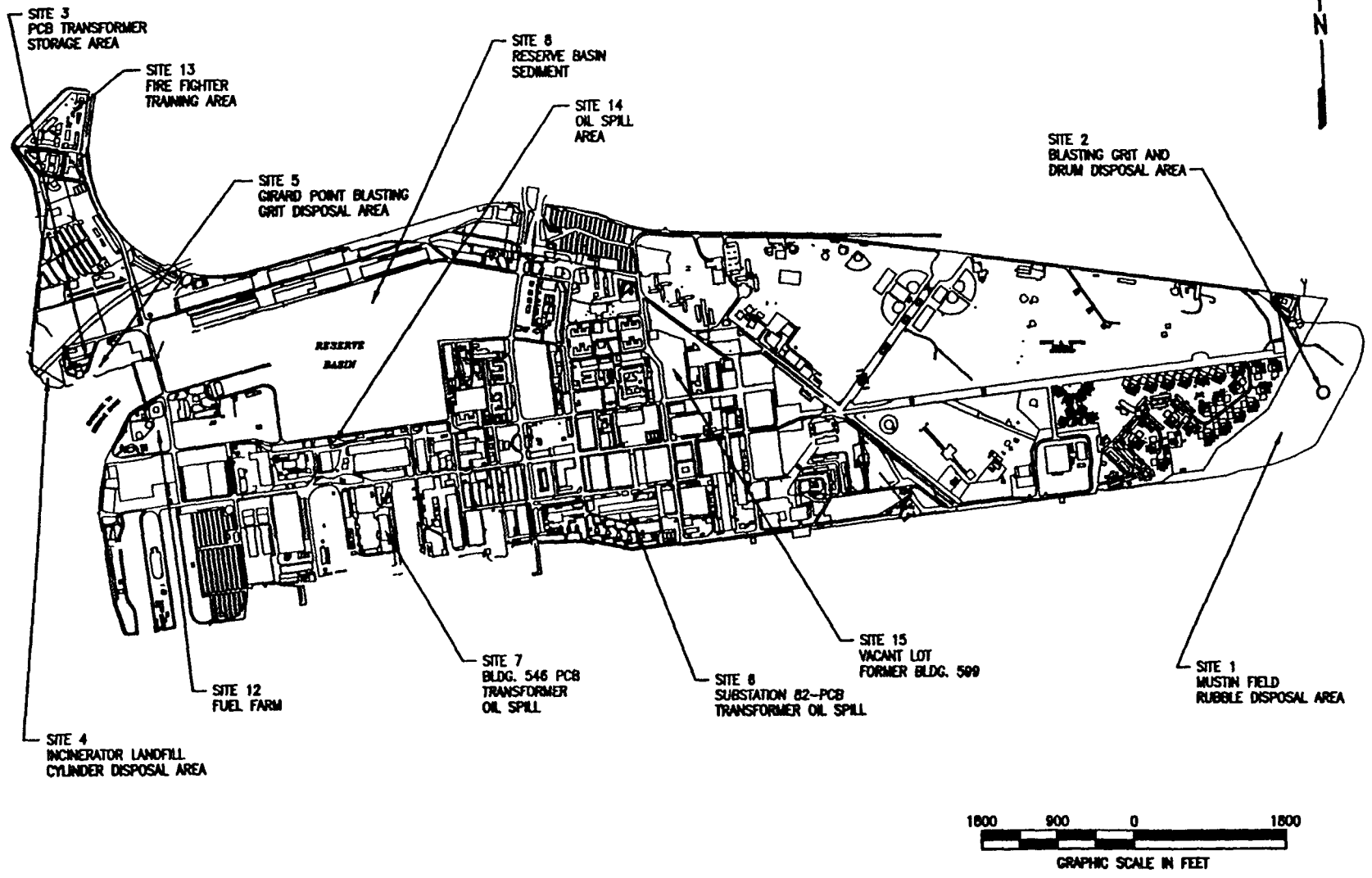
During 1986-1987, the NACIP program was restructured and named the IR Program. In December 1988, the Navy awarded Contract No. N62472-88-C-1291 to Dynamac Corporation to conduct an RI under the Navy IR Program. By that time, 15 sites were included in the IR Program (Figure 2).

Site 13, the Fire Training Area (Figure 3), is located in Zone I, in the northwestern corner of the former NAVBASE. Fire training activities occurred regularly at this site from 1944 through September 1995, and included the distribution and ignition of fuel (diesel, gasoline, and fuel oil) with the subsequent extinguishing of the created fires. The area is completely fenced and covered with asphalt. The water used in extinguishing the fires flowed into drains located near the simulation structures. There drains were piped to oil/water separators with water being discharged to the sanitary sewer and waste oil stored. An underground fuel distribution system is in place at the site.

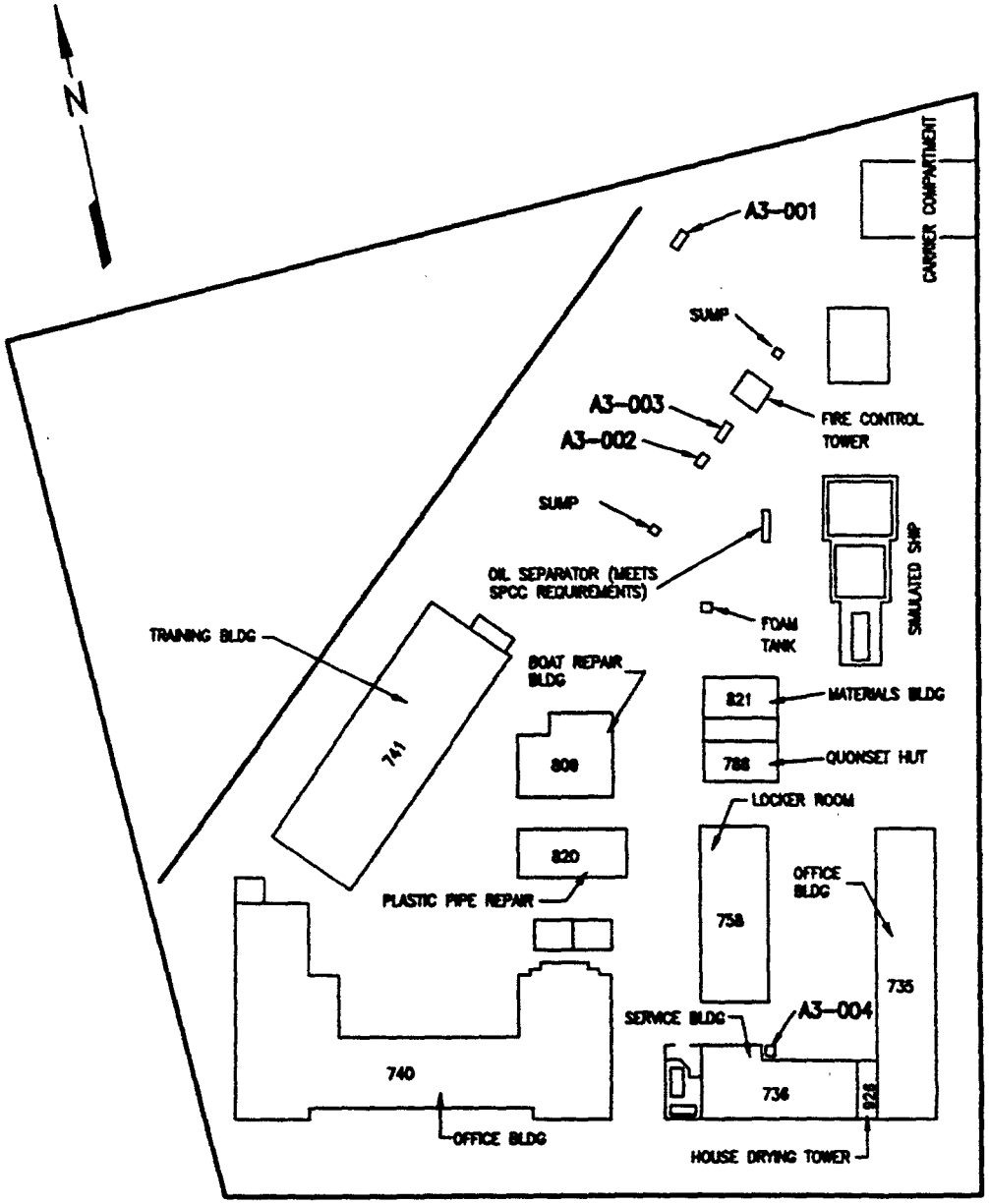
Historically, three underground storage tanks (USTs) supplied diesel fuel, gasoline, and fuel oil to burn stations on the north end of the fire field. However, as a result of failed tank-tightness tests, two of the three USTs (A3-002 and A3-003) were removed in 1990. A third UST (A3-001) was removed from the north end of the site in 1995.

In December 1988, Dynamac Corporation was contracted to conduct an RI under the Navy IR Program. The RI field investigation, which included Site 13, was conducted by Dynamac Corporation during 1990 and 1992, and Dynamac prepared the Draft RI Report. Subsequently, the Draft RI Report was transferred to EA Engineering, Science, and Technology (EA) in October 1993. In September 1994, EA issued a Rough Draft RI Report utilizing data from the Draft RI Report by Dynamac Corporation. EA concluded that additional analytical data were required to complete a quantitative risk assessment on soil and ground water for Site 13.

The USEPA's Environmental Photographic Interpretation Center (EPIC) report for the Philadelphia Naval Complex identifies 14 photographic "signatures" within the boundaries of Site 13 (EPIC 1994). These signatures were described by the photographic interpreters as spills, probable spills, stains, standing liquid, and light-toned material. Field checking of the signatures in 1994 showed no evidence of these signatures as paving of the area may have eliminated these signatures. The investigation of Site 13 encompassed the potential impact from signatures identified at the site.



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.	REMEDIAL INVESTIGATION IR SITE 13 PHILA. NAVAL BASE PHILADELPHIA, PENNSYLVANIA	LOCATION OF IR PROGRAM SITES	DESIGNED BY JET	DRAWN BY PMH/FDM	DATE 8-3-99	PROJECT NO. 29600.10.3295
			CHECKED BY CJR	PROJECT MGR. CJR	SCALE AS SHOWN	FIGURE 2



(SOURCE: DYNAMAC, 1992)

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.	REMEDIAL INVESTIGATION IR SITE 13 PHILA. NAVAL BASE PHILADELPHIA, PENNSYLVANIA	SITE 13 FIRE TRAINING AREA

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1.3 COMMUNITY PARTICIPATION

Community involvement has occurred through the development of the Restoration Advisory Board (RAB) for the Philadelphia Naval Complex. RAB meetings are advertised to the public and are held approximately each month. The RAB is made up of government officials, USEPA and State regulators, and local residents. Community notification of the Decision Document will be provided through a public notice, which will be issued on the "No Further Action" decision for the site.

1.4 SCOPE AND ROLE OF RESPONSE ACTIONS

The site is currently owned by the Navy and is under caretaker status. Once a historical literature review and review of other historical information identified the site as a Navy IR Program site, a Remedial Investigation (RI) using Navy and USEPA Region III guidance was performed which involved the collection of samples and an assessment of human health and environmental risks posed by the site. Under this program, which is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP), the Navy has addressed potential releases to soil, air, surface water, and ground water, and the degree of risk posed.

There are no residential reuse development plans proposed for this site. Therefore, the Navy did not evaluate risk posed to residents at the site. Residential use was not deemed appropriate or consistent with the Community Reuse Plan (City of Philadelphia 1994). As such, there were basewide institutional controls put in place as part of the property transfer that will prohibit future residential use, provide restrictions on outdoor child care, and prohibit use of shallow ground water for human consumption.

2. DESCRIPTION OF THE "NO FURTHER ACTION" DECISION

Based on the human health risk evaluations and ecological assessments performed for the site, there is no current or potential threat to human health or the environment, based on the specified current and future conditions. Therefore, the Navy has determined that there is sufficient data to support a "No Further Action" decision for this site, and that no further action is necessary to ensure protection of human health and the environment.

3. SITE-SPECIFIC INFORMATION

The site-specific information is presented to support the "no further action" decision. Two general aspects of the decision document, the human health and ecological risk assessments, and the nature and extent of COPC, were addressed at the site in a similar manner. Selection of COPC for the media of concern was conducted using regulatory and site-specific (i.e., background) levels. The human health risk assessment and ecological habitat assessment/screening followed similar procedures.

3.1 HUMAN HEALTH RISK-BASED COPC SELECTION

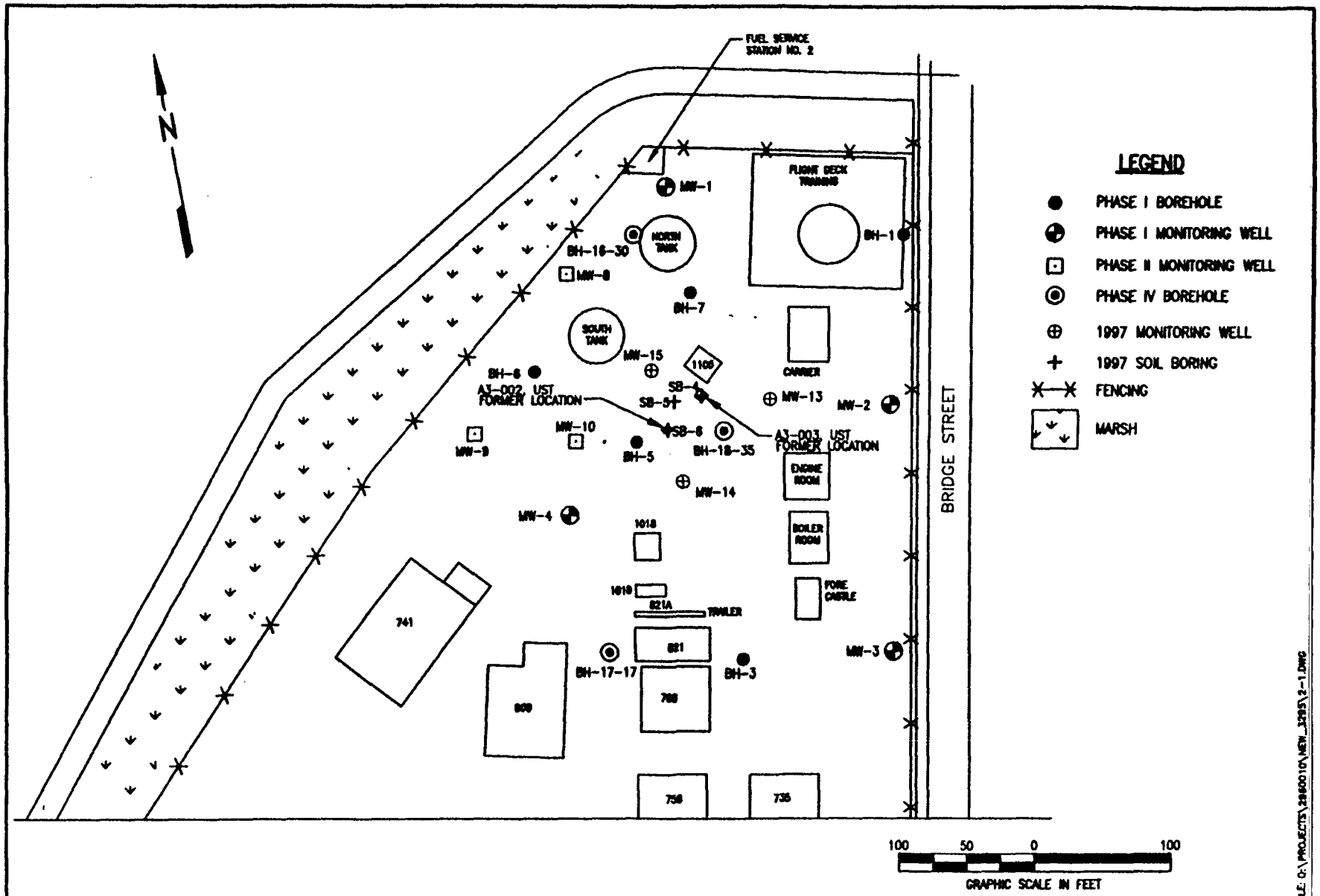
3.1.1 Approach

Soil and ground-water chemistry data were compared to screening criteria, which included USEPA Region III Risk-Based Concentrations (RBCs). Philadelphia Naval Complex background levels, and several other numeric criteria. The applicable RBCs used for data screening included numeric health-based criteria for soil which are based on industrial use of a site (as opposed to residential) and ground-water criteria based on residential exposure[1]. If an industrial RBC was exceeded in soil, then background levels established for the Philadelphia Naval Complex were considered as a secondary criterion, if they were higher than the RBC value. When these criteria were exceeded by respective analyte concentrations from samples collected at the site, further evaluation of the conditions at the site was warranted. Sample analytical results that exceeded the published numeric criteria and, if applicable, Philadelphia Naval Complex-specific background levels, were considered COPC.

The RI field sampling was conducted in four phases (Figure 4). Phase I sampling was conducted in April and May 1990 by Dynamac. Phase I activities included subsurface sampling, the installation of four monitoring wells, conducting two sets of water level measurements from the four wells, collecting ground water sampling from the wells, and conducting a location and elevation survey.

Phase II was conducted during 1991 and 1992 by Dynamac. Activities undertaken in Phase II were chosen to address data gaps that were identified following review of Phase I results. These activities included additional subsurface sampling, the installation of three additional monitoring wells, the collection of ground-water samples, water level measurements, performing a location and elevation survey, examining laboratory data to evaluate the quality, validity, and usefulness of the chemical analyses for site characterization, and the analyses of chemical and geological data.

[1] EPA does not publish Industrial RBCs for tap water, so the residential exposure-based RBCs were used as a conservative screen of ground-water data.



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EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

REMEDIAL INVESTIGATION
IR SITE 13
PHILA. NAVAL BASE

BOREHOLE AND MONITORING WELL LOCATIONS

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EA conducted Phase III during 1993 and 1994. The field activities were performed in order to supplement data from the previous phases of the investigation and to further characterize the sites at the request of the Pennsylvania Department of Environmental Protection (PADEP). Activities undertaken during the Phase III investigation included ground-water gauging of monitoring wells, aquifer testing (slug tests) on a select number of wells, and ground-water sampling with analysis for total lead.

EA recommended a Phase IV field effort, which was conducted in July 1995. This effort provided sufficient spatial characterization of the nature and extent of constituents present in soil and ground water at Site 13 to support a human health risk assessment in accordance with USEPA Region III guidance. Activities undertaken during the Phase IV investigation included subsurface soil sampling at three locations, redeveloping the seven existing monitoring wells, and data validation. The data validation was performed in accordance with USEPA Region III guidance and Naval Facilities Engineering Services Center (NFESC), formerly Naval Energy and Environmental Support Activity (NEESA), Level D data quality objectives.

3.1.2 Phase I RI Field Sampling

During Phase I, subsurface soil samples and ground-water samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOC) and semivolatile organic compounds (SVOC).

Five soil borings were drilled at Site 13 to characterize the subsurface and assess possible sources of COPC. Two soil samples were collected for analysis from each of the five borings and four well boreholes.

Total SVOC were identified as elevated in the 5-7 ft sample from BH-5 and BH-6. These concentrations were attributed to site activities and found to warrant three additional soil borings/monitoring well installations with two soil samples per borehole.

Four monitoring wells were installed to provide data concerning ground-water quality, local aquifer characteristics, and the direction of ground-water flow.

3.1.3 Phase II RI Field Sampling

During Phase II, additional ground-water samples were collected to further investigate the concentrations and extent of constituents detected during Phase I. The soil samples collected during Phase II were used to further characterize the site-specific geology and the vertical and lateral extent of previously detected constituents. Based on results of Phase I sampling, Phase II soil and ground-water samples were analyzed for benzene, toluene, ethylbenzene, and total xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAH).

Seven subsurface soil samples were obtained and three monitoring wells were installed. All samples, except for one monitoring well sample, were analyzed for VOC, PAH, and BTEX.

The additional monitoring wells were used to further characterize water quality and ground-water flow direction. Additional hydrogeologic activities included another round of ground-water gauging and the collection of three ground-water samples and one duplicate sample. The ground-water samples were submitted to the laboratory for the analysis of VOC, PAH, and BTEX.

PADEP recommended that total lead values for ground-water be provided to support a request for closure of Site 13. Water-level gauging and falling/rising head well tests were also needed to supplement the characterization of the aquifer.

3.1.4 Phase III RI Field Activities

Field activities during Phase III included well gauging and aquifer testing. No soil sampling was conducted. The water levels were measured in the monitoring wells at Site 13 for comparison to gauging data obtained during Phases I and II. Falling and rising head slug tests were conducted in three monitoring wells to evaluate hydraulic conductivities. The hydraulic conductivities and the hydraulic gradients calculated from gauging data formed the basis for calculation of ground-water velocities. A round of ground-water sampling was conducted in all seven wells. The samples were submitted for laboratory analysis of total lead.

3.1.5 Phase IV RI Field Activities

With the need for a quantitative human health risk assessment (HHRA) becoming evident after Phase III, it was determined that the database of analytes and locations was not adequate for compliance with USEPA Region III guidelines. This resulted in random sampling with expanded analytical parameters in Phase IV.

Field activities during Phase IV consisted of well re-development, subsurface soil sampling, and ground-water sampling. Three subsurface soil samples were obtained. Samples were analyzed for TCL VOC, TCL SVOC/PAH, pesticides/polychlorinated biphenyls (PCB), Target Analyte List (TAL) metals and cyanide.

3.1.6 Nature and Extent of Contamination

The purpose of this section is to integrate the Phase I through IV data into a concise conceptual framework that describes the relationship between COPC in soil and ground water. Table 1 summarizes COPC for subsurface soil and ground water. This table can be used to assess whether Site 13 subsurface soil contains constituents that have impacted ground water by tracking COPC from one medium to another. For example, if COPC in subsurface soil are

TABLE 1 CONSTITUENTS OF POTENTIAL CONCERN BY MEDIA ABOVE SCREENING CRITERIA

	Parameter	Subsurface Soil (above RBC and Background)	Ground Water (above RBC and MCL)
Volatiles	Chloroform	No	Yes[(a)]
	1,2-Dichloroethene	No	Yes[(a)]
	Methylene Chloride	No	Yes
	1,1,2,2-Tetrachloroethane	No	Yes[(a)]
	Vinyl Chloride	No	Yes[(a)]
Semivolatiles	Benzo(a)anthracene	Yes	Yes
	Naphthalene	No	Yes[(a)]
	2-methylnaphthalene	No	Yes
	Benzo(a)pyrene	Yes	No
Metals	Arsenic	No	Yes[(a)]
	Iron	No	Yes
	Lead	Yes	Yes
	Manganese	No	Yes

(a) Indicates above RBC but not MCL for ground water.

to impact ground water, then there must be leaching of constituents from soil to ground water.

No VOC detected in subsurface soil samples exceeded RBC. In ground water MW-9 showed detections of VOCs that were below the MCL, but above the RBC. Detections in ground water, other than trace chloroform in a sample from MW-2, were from a sample taken from well MW-9. These values, while in excess of the RBC, did not exceed the corresponding maximum contaminant level (MCL). With no values above the RBC for soil and trace values in ground water. VOC are not considered to be of concern with respect to Site 13 acting as a source.

These trace sources in ground water may be artifacts of past site usage when low (i.e., ppb) ranges of VOC may have leached from soil. EPIC photographs indicate that most of the observed former activity occurred from 1960 to the mid-1970s. Any remnant VOC may be the result of constituents that have been throughly flushed and degraded over the past 20 to 35 years. In light of the limited use potential of the local ground water as a potable source, the fact that the MCLs were not exceeded for VOC, the trace level VOC is not of concern.

Two PAH were detected at concentrations in excess of the RBCs in soil. The detections of benzo(a)pyrene were in samples typically 5 of 7 ft below grade and were widely distributed across the site. Benzo(a)anthracene was only detected in one soil sample at 5 to 7 ft below grade, but was also detected in a ground-water sample at a separation location. This concentration was above the RBC and MCL criteria.

Four metals (arsenic, iron, lead, and manganese) were detected in either ground-water and/or subsurface soil samples above the RBCs. For subsurface soil, lead was above the screening level and background limits; arsenic concentrations were below the soil background limits. No sample values for manganese were above the screening criteria soil. Lead was detected above the screening level in shallow soil samples (1 to 2 ft) collected in the central and south-central portion of the site.

Total lead concentrations in six Phase II ground-water samples were above the screening criteria and most values were above the action level (AL). Dissolved lead was not detected during Phase IV. The Phase IV sample values for lead are lower than Phase III, possibly due to use of a slow-pumping technique during well purging. This method would have increased laminar flow, which should have provided a less turbid sample. Iron concentrations greater than the RBC were reported in four samples. Both total and dissolved arsenic were detected at concentrations in excess of the RBC; however, only one sample of total arsenic exceeded the MCL. Manganese, despite being below the screening criteria in soil, had values from ground-water sample analysis greater than the RBC and MCL for both total and dissolved fractions.

Metal COPC (arsenic, iron, lead, and manganese) in ground water were found in greater concentrations in the lower water-bearing zone.

3.1.7 Fate and Transport

Three major processes govern the transport of organic compounds: solubility, transport phenomena (advection and dispersion), and adsorption. Solubility governs the ability for migration into ground water, advection and dispersion control transport through ground water, and adsorption controls initial release from soil and retardation of ground-water transport processes.

COPC are described in terms of factors affecting migration, potential routes of migration, and environmental stability.

VOC migration is governed by low octanol-water partition coefficients, which cause a weak partitioning to sediment organic matter. Solubilities are moderate to high, and natural attenuation will proceed at a moderate rate, given a satisfactory environment. The VOC chloroform, 1,2-dichloroethene (DCE), 1,1,2,2-Tetrachloroethane (PCA), and vinyl chloride were identified in ground-water samples as COPC. These compounds have very high to high mobility in ground water, no corresponding detections in subsurface soil, and concentrations two to three orders of magnitude below the water solubility. These data give little indication of an onsite source.

PAH migration appears to be severely limited. Organic carbon in the sediments will effectively sorb these compounds. Transport through ground water governed by retardation coefficients is so low as to consider constituents of concern immobile. Low vapor pressures indicate that volatility of PAH is not of concern.

Metals migration is influenced by a large number of factors. The distribution coefficient, K_d, for metals varies widely, with clays having the highest values. Inorganic adsorption varies between chloride (weakly adsorbed) to lead, cadmium, mercury, and zinc (strongly adsorbed). The transport of lead was empirically modeled. Calculated soil pore-water concentrations show estimates for source area concentrations. Comparisons to dissolved ground-water sample concentrations indicate that dilution and potentially higher soil sorption are affecting the downward concentrations of metals in ground water.

Possible routes of migration include ground-water flow and air transport. The ground-water-flow pathway was considered for water infiltrating through a spill or fill materials, or direct water-table contact on spill or fill materials. This water contact has the potential to create a solute that can transport chemical constituents. Pavement at the site eliminates air transport of surficial soil particles. Air transport of volatile emissions from subsurface soil appears to be limited, since VOC were not detected above screening levels. Venting from ground water to air also appear limited, given low microgram per Liter (µg/L) concentrations reported in the samples.

3.2 HUMAN HEALTH RISK ASSESSMENT

3.2.1 Approach

The purpose of the HHRA was to determine whether there are potential human health risks associated with current and future potential human exposures to subsurface soil, ground water, and ambient air containing COPC at or in the vicinity of Site 13. Risks associated with potential onsite human exposures to COPC were evaluated for the following receptor populations: future construction/excavation workers, and future commercial/industrial workers.

For all receptor populations, potential health risks were evaluated for adults only. In accordance with recent USEPA guidance that realistic future land use plans be considered in evaluating potential health risks (USEPA 1999), future residents were not included as receptors of concern in the human risk assessment. Future land reuse plans for the former Philadelphia Naval Base have been extensively developed and do not include residential housing (City of Philadelphia 1994).

As discussed in Section 1.1, the use of shallow ground water as a drinking water source or for crop irrigation is not considered to be an exposure pathway of concern because the shallow aquifer is not potable (i.e., there is insufficient yield of water and the water quality is poor). Drinking water in the Philadelphia area is supplied by public water systems, and no private shallow wells are used for drinking water or for crop irrigation. Furthermore, it is assumed that the drinking water supply at NAVBASE and in surrounding areas will always be derived from public water supply sources that do not originate in the shallow aquifer. Therefore, ground water as a drinking water source is not a current or future complete exposure pathway (EA 1995). Ground water concentrations were used in the construction/excavation exposure considering incidental exposure.

Surface soil was not considered to be a medium of concern at Site 13 because it is an incomplete exposure pathway. Currently, the site is completely paved with asphalt and there is no exposure to surface soil. Therefore, if there are no future plans for site development, there will be no exposure to surface soil. Furthermore, if there are plans for future development of the site, it is likely that the asphalt will be removed. Bulldozers and other heavy equipment are not able to remove only the asphalt, but will also remove the soil immediately underlying the asphalt and pavement. Therefore, there will be no future exposure to surface soil for construction/excavation workers and commercial/industrial workers.

There was some concern that runoff from Site 13 into a ditch running alongside the northwest site boundary might have adversely impacted the soil in the ditch and surrounding areas. This ditch drains an adjacent road which is used for entry/exit to a municipal trash transfer station and private metal recycler. The paved portion of Site 13 drains away from this ditch into catch basins within the site and as such spillage would not effect this ditch.

3.2.2 Summary of Risk Estimates for Health Effects Other Than Cancer

Risks for health effects other than cancer were expressed as hazard quotients (HQs) or hazard indexes (HIs), which are estimates of the potential for adverse health effects. Under the specified conditions of exposure, using reasonable maximum exposure scenarios, the HQs and HIs for all receptor groups were less than one. These findings indicated that under the specified conditions of exposure, there were not likely to be any risks for adverse health effects other than cancer associated with future anticipated site use by construction/excavation workers.

	Reasonable Maximum Exposure
Construction/excavation worker	0.042
Commercial/industrial worker	Not applicable

The non-cancer exposure for commercial/industrial worker could not be evaluated since the COPCs (benzo(a)pyrene & benzo(a)anthracene) do not have associated non-cancer reference dose.

3.2.3 Summary of Risk Estimates for Cancer

Chemical-specific, pathway-specific, and total excess lifetime cancer risks from exposure to site-related COPC were estimated for each receptor population of interest. For future construction/excavation workers under specified conditions of exposure, the total excess lifetime cancer risk was $2x\ 10^{-6}$ using reasonable maximum exposure parameters. Subsurface soils were used for commercial/industrial workers. Surface soil data was not used since the area is paved.

	Reasonable Maximum Exposure
Construction/excavation worker	$2\ X\ 10^{-6}$
Commercial/industrial worker	$2\ X\ 10^{-6}$

The interpretation of the significance of these cancer risk estimates is based on the appropriate public policy. USEPA (1990), in the NCP (40 CFR Part 300), states that:

> For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}.

Therefore, on the basis of NCP standards and under the specified conditions of exposure, estimated risk levels fall within the acceptable level for all receptor populations of interest.

For construction/excavation workers, specific COPC in certain exposure pathways accounting for almost all of the estimated excess cancer risk were inhalation of chloroform, 1,1,2,2-trichloroethene (TCE), vinyl chloride, and exposure to arsenic via incidental ingestion of ground water and dermal contact with subsurface soil.

3.2.4 Comparison with Risk Assessment for UST Investigation

As discussed in Section 1.2, two USTs (A3-002 and A3-003) were removed from Site 13 in 1990. A risk assessment was conducted in conjunction with the investigation. Results from the A3-002 and A3-003 risk assessment using the same risk assessment methodology indicated no unacceptable risk. Reasonable maximum exposure (RME) cancer and noncancer risk for A3-002 and A3-003 were $1x10^{-6}$ and 0.04, respectively.

3.3 ECOLOGICAL RISK ASSESSMENT

The only area at Site 13 covered with vegetation is a small ditch that abuts the site to the west, bordering an active roadway. This drainage ditch does not receive stormwater runoff from Site 13 or discharge from Site 13. The surface water runoff is channeled towards the center of the site to stormwater sewer lines. Ecological risk assessment begins with evaluation of potential exposure routes (USEPA 1994). At Site 13, completed exposure pathways for ecological receptors to COPC present in soil do not exist. There is no exposed surface soil to support a terrestrial food web, and the fence precludes movement of most wildlife across the site. Pigeons and other common urban birds may roost on structures on or adjacent to IR Site 13, but the lack of exposed surface soil at the site indicates that there would be no exposure of COPC in the soil to these transient birds. Furthermore, USEPA guidance states that habitat utilization should be a key factor in endpoint selection and assessment (USEPA 1994). Site 13 is not utilized as an ecological habitat; birds which may be present at the site as occasional visitors would not be expected to feed for any substantial amount of time at the site and would not be exposed to surface soil because of the extensive paving. Therefore, there are no ecological exposure issues at this site.

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